

Risk factors for biliary tract injuries during laparoscopic cholecystectomy

Adelina Papancea¹, Bogdan Mihnea Ciuntu^{1*}, Stefan Georgescu¹, Dan Vintila¹, Alin Vasilescu¹, Lili Lozneanu¹, Liliana Fortu, Cirdeiu Ciprian¹, Ludusanu Andreea¹, Nutu Vlad¹, Andronic Dan¹, Bradea Costel¹, Cristian Lupascu¹

¹„Grigore T. Popa” University of Medicine and Pharmacy Iasi, Romania; Department of General Surgery, St. Spiridon University Hospital, Iasi, Romania;

Abstract. Risk factors for biliary tract injuries during laparoscopic cholecystectomy. Laparoscopic cholecystectomy has become a standard in the treatment of gallstones, which made the method quickly accepted by patients and doctors. In addition, the technique offers superior aesthetic results through the minimally invasive approach, reduces postoperative pain charges and reduces hospitalization of patients, having a higher cost / benefit ratio than the classic technique. But the "tribute" paid to the minimally invasive approach is to increase the number of bile duct injuries, due to the two-dimensional image in which it is worked, thus making it more difficult to appreciate the depth, and the impossibility of using the sense of touch. **Material and methods:** We conducted a retrospective study of all patients by comparing two lots of patients who underwent elective and emergency laparoscopic cholecystectomy in First and Second Surgical Clinic Iasi, Romania, between 1993-2005 and, respectively between 2016-2021. From this study groups, we selected the patients with bile duct injuries during laparoscopic cholecystectomy, and compare the two study lots. **Results** For the first group we evaluated retrospectively the medical records of 8502 patients who benefited from cholecystectomy over a period of 12 years. From this total number of patients, we identified 31 cases with biliary lesions produced during this intervention. For the second group we evaluated retrospectively the medical records 2499 of patient who underwent laparoscopic cholecystectomy, we identified 18 cases with biliary lesions. In both lots the biliary lesions produced was 0,3 %. **Conclusions** Surgical training alone cannot prevent the appearance of lesions, the best method of dealing with biliary lesions is to prevent them. This requires an excellent knowledge of the anatomy of the region and the possible anatomical variants.

Keywords: biliary injury, laparoscopy, cholecystectomy

INTRODUCTION

Laparoscopic cholecystectomy has become a standard in the treatment of gallstones, which made the method quickly accepted by patients and doctors. In addition, the technique offers superior aesthetic results through the minimally invasive approach, reduces postoperative pain charges and reduces hospitalization of patients, having a higher cost / benefit ratio than the classic technique. The number of days of hospitalization decreased from an average of 3.7 to 1.2 days, and the postoperative recovery from an average of 43 to 8 days [1]. However, the new method has also led to an increase of intraoperative accidents and thus of postoperative complications,

corresponding to the learning curve [2]. The major disadvantages of the laparoscopic technique are the two-dimensional image in which it is worked, thus making it more

Corresponding authors: bogdan.ciuntu@umfiasi.ro (BMC)

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difficult to appreciate the depth, the impossibility of using the sense of touch, sometimes of major importance and the somewhat limited possibility of movement, given by the positioning of the trocars [3].

Postoperative morbidity in patients with laparoscopic reoperations does not differ significantly from that seen in patients who after laparoscopic surgery did not develop complications that would require surgical reintervention [4]. However, in terms of complications, postoperative morbidity in laparoscopic cholecystectomy is limited, but some complications occur more frequently than in open cholecystectomy: bilirages, coleperitoneum, postoperative bleeding, intraperitoneal abscesses. These are early postoperative complications, for which reintervention is generally required [5].

Usually, mortality in laparoscopic cholecystectomy is similar to that in open cholecystectomy. But much less often the death is due to the surgical cause, usually the cause is explicit by the result of the associated strains represented by bile duct lesions [6], we remind the reader of the classifications according to Bismuth H. et al and Strasberg-Soper.

Classification according to Bismuth H. et al:

- type I: CBP lesions at more than 2 cm of liver conflict;
- type II: CBP lesions less than 2 cm from the liver bifurcation;
- type III: CBE lesions in which only the confluence ceiling is intact;
- type IV: lesions of the conflict that section both hepatic ducts;
- type V: strictures of CBP and right liver [7].

Strasberg and Soper in 1995 classifies iatrogenic biliary lesions:

- type A: lesions of the cystic duct or of the aberrant canals in the hepatic bed of the vesicle;
- type B: aberrant segmental canal ligatures of the right lobe;
- type C: the section of such a channel;
- type D: lateral lesions of CBP;
- type E: complete sections or obstructions (ligatures) of CBP. This type is subdivided according to the location of the lesion, similar to the Bismuth classification [8].

MATERIAL AND METHOD

We conducted a retrospective study of all patients by comparing two lots of patient who underwent elective and emergency laparoscopic cholecystectomy in First and Second Surgical Clinic Iasi, Romania, between 1993-2005 and, respectively between 2016-2021. The information was obtained retrospectively from the register of the hospital archive and from the observation sheets.

In both groups we took in consideration the surgical training and operating experience of the operating team, we studied local factors, biliary tract abnormalities, anatomical modification due to gallstone disease evolution. From this patients we selected the cases with bile duct injuries due to laparoscopic cholecystectomy, rate of conversion to clasic laparotomy, the cause for this approach, and investigated the type and grade of the biliary injury, as well as the treatment applied. The lesions produced were classified according to the Strasberg's classification. Note that types E1-E5 correspond to the Bismuth classification.

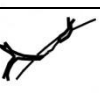
RESULTS

For the first group we evaluated retrospectively the medical records of 8502 patients who benefited from cholecystectomy

over a period of 12 years. From this total number of patients, 7092 (83%) underwent laparoscopic cholecystectomy. Conversions (361 cases-5%) were necessary for intraoperative reasons (hemorrhage, suspected biliary lesion, lost stones in the peritoneum, ileal perforation, clip skidding, technical defects, anaesthetic causes) in 62 cases (0.8%) and deliberate (acute gangrenous cholecystitis, plastron, scleroatrophic cholecystitis, adhesions, cystic lithiasis, choledochal lithiasis, biliary fistulas, abdominal tumors, uncertain anatomy, odditis) in 299 cases (4.2%).

We identified 31 cases with biliary lesions produced during this intervention (0.3%), to which were added two more patients initially operated in other services. According to the Strasberg classification, 15 patients had type A lesions, which did not cause any significant problems, the rest having more serious lesions (type C, D and E), only these remaining in our attention for further analysis in Table 1.

Serious biliary lesions (Strasberg C, D, E) occurred in 3 men (16.7%) and 15 women (83.3%) with a mean age of 52.4 ± 10.4 years (extreme 35 and 72 years).

TYPE		DESCRIPTION	n	%
A		Biliary leakage from the cystic duct or from a small bile duct in the gallbladder bed	15	45.5
B		Ligature of an aberrant hepatic channel	-	-
C		Section of a right aberrant hepatic channel without ligature	1	3.0
D		Lateral wound of the main bile duct	13	39.4
E ₁₋₂		Complete section of the main bile duct: - at over 2 cm convergence (E ₁); - less than 2 cm convergence.	2	6.1
E ₃		Clip / section of the common bile duct convergence	-	-
E ₄		Stenosis of the common bile duct convergence	-	-
E ₅		Stenosis of the common bile duct convergence with section of a right aberrant hepatic channel	2*	6.1
TOTAL			33	100

*Initially operated in other services

Table 1. Strasberg classification of biliary lesions during laparoscopic cholecystectomy (n = 33; First Surgery Clinic Iasi; 1993-2008).

In their operative protocols, regarding laparoscopic cholecystectomy, we looked for information on the conditions and the way of the accident. From all 18 cases with severe biliary lesions in 5 cases (27.8%) the biliary accident was recognized intraoperatively (and implicitly resolved under the same anesthesia), in the other patients the complication was subsequently reported by: biliary leakage in the peritoneal cavity (n = 9; 50%) and only significant biliary leakage on the placed drain tube subhepatic (n = 4; 22.2%). Obstructive jaundice was added to 3

patients. Each operating surgeon had performed at least 48 laparoscopic cholecystectomies without complications at the time of the accident, so from the point of view of the operator's experience we can consider the homogeneity of our group.

From the medical documents we identified a series of factors that seem to be associated without a doubt with the risk of biliary lesions during the laparoscopic surgery, which we classified as: lesional and anatomical in Table 2.

		Subject																	
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Factor risk	Acute cholecistitis	☑	☑	☑	☑	☑	☑					☑			☑			☑	☑
	Sclero-athrofic gallbladder							☑	☑	☑		☑	☑		☑				
	Thick wall gallbladder	☑	☑		☑	☑		☑	☑			☑	☑		☑	☑		☑	☑
	Gallbladder hydrops	☑		☑		☑	☑				☑			☑		☑		☑	☑
	Infundibulum stone			☑		☑	☑		☑			☑			☑		☑		
	Gallbladder adhesions		☑		☑			☑	☑	☑	☑	☑	☑		☑		☑	☑	☑
	Gallbladder adherent to liver	☑	☑				☑		☑		☑		☑			☑			☑
Anatomic changes	MIRRIZI I													☑					
	MIRRIZI II							☑				☑							
	No cystic with normal main biliary tract									☑						☑	☑		
	NR. RISK FACTOR/CASE	4	4	3	3	4	4	4	5	3	3	5	5	2	4	5	3	4	5
STRASBERG		C	D	D	D	D	D	D	D	D	D	D	D	D	D	E1-2	E1-2	E5	E5

☑ - present factor; ☐ - absence factor

Table 2. Distribution of lesional and anatomical risk factors in each case with severe biliary lesions following laparoscopic cholecystectomy (n = 18; I Surgery Clinic Iasi; 1993-2005).

For the second group we evaluated retrospectively the medical records 2499 of patient who underwent laparoscopic cholecystectomy. We identified 16 cases with biliary lesions produced during this intervention (0.3%), to which were added

seven more patients initially operated in other services. According to the Strasberg classification, 5 patients had type A lesions, which did not cause any significant problems, the rest having more serious lesions (type C, D and E), only these remaining in our attention for further analysis in Table 3.

TYPE	DESCRIPTION		n	%
A		Biliary leakage from the cystic duct or from a small bile duct in the gallbladder bed	5	31.2
B		Ligature of an aberrant hepatic channel	-	-
C		Section of a right aberrant hepatic channel without ligature	1	6.2
D		Lateral wound of the main bile duct	5	31.2
E ₁₋₂		Complete section of the main bile duct: - at over 2 cm convergence (E1); - less than 2 cm convergence.	1	6.2
E ₃		Clip / section of the common bile duct convergence	1	-
E ₄		Stenosis of the common bile duct convergence	2	12.4
E ₅		Stenosis of the common bile duct convergence with section of a right aberrant hepatic channel	1*	6.2
TOTAL			16	100

Table 3. Strasberg classification of biliary lesions during laparoscopic cholecystectomy (n = 16; First Surgery Clinic Iasi; 2016-2021).

The factors associated with the risk of biliary lesions during the laparoscopic surgery identified in the second lot are listed in Table 4, by the same classification, lesional and anatomical.

From all 11 cases with severe biliary lesions in 2 cases (18.1%) the biliary accident was recognized intraoperatively (and implicitly resolved under the same anesthesia), in the other patients the complication was subsequently reported by: biliary leakage in the peritoneal cavity (n = 5;

45,4%) and only significant biliary leakage on the placed drain tube subhepatic (n = 4; 36.3%). Obstructive jaundice was added to 2 patients (16.7%). The second lot of patients had the same surgical staff.

Completing the investigation with the protocols of reinterventions for resolving biliary lesions, the next pathogenic causes were found:

- The main bile duct was confused with the cystic channel, but the lesion has

been recognized intraoperatively;

- Lateral injury of the main bile duct by clipping or cauterization, bleeding being associated with reduced visibility;
- The main bile duct was confused with the cystic but unrecognized, main bile duct, common hepatic duct, right or

left hepatic canal being sectioned or resected;

- Right hepatic tract was confused with the cystic channel;
- Right hepatic artery confused with the cystic artery, right hepatic canal and sectioned hepatic artery;
- Lateral wound of the right hepatic canal by cauter or clip.

	Subject										
	Z	2	3	4	5	6	7	8	9	10	11
Acute cholecistitis	☑	☑			☑	☑	☑	☑		☑	☑
Sclero-athrofic gallbladder			☑						☑		
Thick wall gallbladder	☑	☑	☑	☑	☑		☑	☑	☑		
Gallbladder hydrops						☑				☑	
Infundibulum stone		☑		☑		☑				☑	☑
Gallbladder adhesions	☑	☑	☑		☑			☑	☑		
Gallbladder adherent to liver			☑	☑	☑		☑		☑	☑	
MIRIZI I											
MIRIZI II				☑		☑					
No cystic with normal main biliary tract			☑								
NR. RISK FACTOR/CASE	3	4	4	4	4	4	3	3	4	4	2
STRASBERG	C	E2	E5	D	E4	D	E4	D	E4	D	D

Table 4. Distribution of lesional and anatomical risk factors in each case with severe biliary lesions following laparoscopic cholecystectomy (n = 11; I Surgery Clinic Iasi; 2016-2021).

DISCUSSIONS

Major risk factors in the occurrence of biliary ductal injury during laparoscopic cholecystectomy are represented by the lack of experience of the surgeon, local anatomy altered, presence of excess perivisceral adiposity, as the literature reveals [9-14]. For the young surgeon the need for a learning curve is mandatory, in order to gain operating experience, to be able to appreciate in time the technical difficulties that a concrete situation raises during interventions, classic or laparoscopic. However, surgical training alone cannot prevent the appearance of

lesions, as evidenced by their appearance in surgeons with experience in biliary pathology, maybe to lack of concentration, inattention or trivialization of cholecystectomy.

This study compared the frequency of the biliary injuries in two different periods of time. At the beginning of the laparoscopy in our centre and later when the experience of the surgeons was already formed. The rate of the biliary injuries was 0,3 % in both lots of patients, as the value cited by other studies [15-19].

The presence of local anatomy altered creates intraoperative situations in which

laparoscopic colecistectomy is extremely difficult to perform. We can observe that the increase number on local lesional and anatomical risk factors in our patients conducted to a severe lesion (in a type E5 lesions were 4 risk factors incriminated). And we must acknowledge the factors don't increase the risk by themselves but the biliary lesions are secondary to a combination of factors that creates extremely difficult intraoperative conditions in terms of correct anatomical identification and exposure of the subhepatic region. The most cases in our studies, in the both lots was the local modification made by acute inflammation of the subhepatic region, adhesions that cause significant bleeding during viscerolysis, covering the operating field, making orientation difficult and risky surgical maneuvers.

Cholecysto-choledochal fistulas (Mirizzi syndrome type I) occur in approximately 0.05-4% of cholecystectomies patients [19]. Bilio-digestive fistula has a similar incidence [20]. The acquired absence of the cystic duct has been reported in very few cases, but there are discussions whether this anatomical variant can appear in the evolution of chronic cholecystitis or is somehow not only congenital [21].

Studies have shown an incidence of type A lesions of 17-20% [22-25]. In our study, compared to the number of cholecystectomies performed, type A lesions were found in 45.5% of cases in the first lot, and 31% in the second lot, reporting to the total number of biliary injuries. The more severe injuries (type D) occurred most frequent, 39% in the first lot and 31% in the second lot, with a decrease of 4%.

Immediate recognition of the lesion and surgery has the advantage of encountering a supple bile duct, without the presence of sepsis, without inflammatory processes in the vicinity or retractable scars.

In our study the immediate recognition of the lesion and intraoperative reparatory procedure was possible in approximately 20%.

Another issue with the laparoscopic surgery is regarding the surgical technique, the operator acts only on the basis of the two-dimensional image displayed on the monitor, in contrast of classic surgery, where three-dimensional visual perception is complemented by haptic perception (feeling).

CONCLUSIONS

The best method of dealing with biliary lesions is to prevent them. This requires an excellent knowledge of the anatomy of the region and the possible anatomical variants. In addition, a proper surgical technique is needed that provides good exposure of the hepatoduodenal space, avoids intraoperative bleeding and avoids excessive use of electrocoagulation in the area of the Calot triangle. No anatomical element will be sectioned without an exact identification of it.

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